

The generic configuration of these cars was the first (and so far, until the Forcity can be considered "proven in operation", imho only) successful design for 100% low floor cars, by MAN/Adtranz:

http://en.wikipedia.org/wiki/ADtranz_low_floor_tram

The basic configuration dates back to the late 50s with the (high floor, of course) GT4 cars by Esslingen for Stuttgart et al, the Hansa (later Wegmann) cars for Bremen and the Rathgeber P type cars for Munich. Besides the KT4 from Tatra for various operators in (then) "eastern" Europe.

Production quantities:

High floor cars:

GT4: 350 for Stuttgart plus ~30 for other operators

Hansa: ~60 cars and a similar number of trailers

Rathgeber P: 42 cars and a similar number of trailers.

Tatra KT4: ~1800 (!) cars

Low floor cars:

MAN/Adtranz GT6/8M/N/S: >400 cars

Siemens "Combino Plus/Supra": 64 cars

Siemens Avenio: 8+40+19 cars, currently being delivered

Solaris: 5+15+15 cars, currently being delivered

CNR Tangshan: 5 cars

So over 2000 high-floor and over 500 low-floor cars of this configuration have been built.

A single-articulation car of this type is ~18m in length, compared with ~21m for the "conventional" Jacobs bogie configuration. This yielded the name "short articulated car" ("Kurzgelenkwagen"). Clueless Siemens managers and/or "branding consultants" have recently created the meaningless designation "Einzelgelenkwagen" ("single articulated car"), which is nonsense, because there is no single-articulated Avenio. All of them have at least two articulations.

The main issue was that this type of car had almost the same capacity as a Düwag 6-axle car, although with one bogie less, which reduced cost. Besides, the short articulated cars had less generous "swept envelopes", which allowed them to run on networks that would have been inaccessible for the Jacobs bogie cars without extensive rebuilding of the infrastructure.

The original MAN/Adtranz cars are technically different from their high-floor predecessors since the articulations are not "steered" by any mechanics (or hydraulics). Instead, the individual carbody sections elastically "float" on the bogies (like the "flexifloat" bogie design by Henschel for mainline locomotives), only linked by a single longitudinal rod (for transmission of traction/braking forces). This gives them five degrees of freedom (transversal, vertical and three rotational).

Which results in a very "soft" ride comfort, even on less than perfect track, especially for standing passengers. For example, a driver can "race" them around bends without transition curves, without any transversal "jerks" that "pull out the feet" underneath standing passengers. Back when I was living at Munich, some drivers also practised "streetcar jumping" over the canal bridge in Nymphenburg at full speed. Smooth like a charm. I held my breath the first time.

Since $actio=reactio$, low (smooth) forces on passengers means also low forces on the wheels and tracks. Some cars of this configuration have been reported to run 600.000 km without replacing wheel tyres. For german language readers, a presentation about the mechanics of the Avenio is here:

http://www.ifs.rwth-aachen.de/files/RWTH_IFS-Seminar_2010_3_Richter.pdf

If I'm not mistaken, Wolfgang Richter (the middle initial seems to be mandatory for Siemens employees now) also came from MAN/Adtranz.

Since MAN/Adtranz has built the first working 100% low floor cars based on this configuration (five (!) prototypes went into testing in 1989 iirc), the concept has also been re-engineered by Solaris for Jena and Braunschweig, by Siemens after the Combino disaster and by CNR Tangshan for Samsun. Niigata Transys has built a few cars under license from Adtranz for japanese operators.

The "chief technology whatnot" of Siemens for streetcars (hired after Combino) was afaik the ex-project-manager of the original MAN/Adtranz cars for Bremen/München (Lutz Uebel). Most of the engineering for the Solaris and CNR cars was done by a company that was founded by (ex-)employees after Adtranz closed their site at Nürnberg, before Bombardier took over Adtranz. So the "intra-corporate immune reaction" by the management from Bautzen and Vienna, which was supposed to exterminate the (imho better) competing product has just lead to the resurgence of the same product by three competitors (so far).

Inekon also had offered a car with this configuration to Toronto, as mentioned by Tony.

Besides, Tatra had a design on their drawing boards for a "low entry" car that was based on their KT4, the LT-24V:

<http://www.skd.cz/tramvaje/LT24.htm> (Czech)

<http://www.skd.cz/EN/tramvaje/LT24.htm> (English)

<http://www.skd.cz/DE/tramvaje/LT24.htm> (German)

The color scheme was for Gera.

There was also a design by a russian company (who mostly build military equipment such as nuclear ballistic missile submarines) for St. Peterburg, the PTV-2000 car, that unfortunately never went beyond a CAD model and a reduced scale model:

<http://tram.ruz.net/tramcars/PTV2000/>

<http://transphoto.ru/articles/32/?cid=2> (scroll down towards the bottom)

Ivo Köhler has published a book (in German language only, sorry) about the KT4 that gives some information about the history of cars of this configuration:

<http://tinyurl.com/lsoko6n>

For those who read hungarian (I don't), there's some historic information at:

<http://villamosok.hu/nza/kurz/>

This author even considers the Crotram cars for Zagreb as members of this family. And the bogies for these cars were also made by a company that was "spun off" the MAN/Adtranz site at Nürnberg.

If anyone hasn't seen what streetcars look like when they get built, here are some photos from the Solaris cars for Braunschweig:

<http://tinyurl.com/my3exxa>

Amazing that wiring is **still** such a mess. I would have thought that they are using pre-fabricated looms (made by wiring robots) with connectors these days. Especially since Solaris is a busbuilder by first

vocation.

Still reading? Wow, you're persevering.

Some more photos of the Avenios here, as a recompensation:

<http://flickrhivemind.net/Tags/avenio/Recent>

And some videos that made me shudder about the noise of those inverters and gears:

<https://www.youtube.com/watch?v=AjTeTZRQTKw&t=40s>

<https://www.youtube.com/watch?v=lwsg-n4pClk>

<https://www.youtube.com/watch?v=zYAU0bKIPT8>

These cars don't need bells any more to get pedestrians out of their way.